71 G. CARLTON WORTHEN

Notes on Spraying Peaches and Plums in 1900.

C. O. Townsend & H. P. Gould.

IMPERIAL BUREAU 13 JUL 1921 OF MYCOLOGY

BULLETIN NO. 71

OF THE

MARYLAND AGRICULTURAL EXPERIMENT STATION,

COLLEGE PARK, MD.,

FEBRUARY 1901.

THE
Maryland Agricultural Experiment Station.

CORPORATION.

THE BOARD OF TRUSTEES OF THE MARYLAND AGRICULTURAL COLLEGE.

Agricultural (Station) Committee of the Board of Trustees

GOVERNOR JOHN WALTER SMITH, (Ex-Officio).....Annapolis.
HON. CHARLES H. STANLEY (Chairman).....Laurel.
HON. CHARLES W. SLAGLE.....Baltimore.
HON. DAVID SEIBERT.....Clear Springs.
HON. MURRAY VANDIVER.....Havre de Grace.
W. SCOTT WHITEFORD, ESQ.....Whiteford.
ALLEN DODGE, ESQ.....Washington, D. C.

Station Officers and Staff.

HARRY J. PATTERSON, B. S.....*Director and Chemist.*
JAMES S. ROBINSON.....*Horticulturist.*
MILTON WHITNEY.....*Soil Physicist.*
SAMUEL S. BUCKLEY, D. V. S.....*Veterinarian.*
CHARLES O. TOWNSEND, M. S. Ph. D...*Plant Pathologist.*
W. T. L.TALIAFERRO A. M.....*Agriculturist.*
E. O. GARNER.....*Farm Superintendent.*
CHARLES F. DOANE, M. S. Ag.....*Assistant Dairyman.*
HARRIS P. GOULD, M. S. Ag.....*Assistant Entomologist.*
T. M. PRICE, M. S.....*Assistant Chemist.*
F. P. VEITCH, M. S.....*Assistant on Soil Work.*
RAYMOND H. POND, M. S.....*Assistant Pathologist.*
JOSEPH R. OWENS, M. D.....*Treasurer.*
DONALD EVERSFIELD, A. B. .....*Clerk.*

The Station is Located on the B. & O. R. R. and City & Surburban Electric Car Line, 8 miles north of Washington, D. C.

Visitors will be welcomed at all times, and will be given every opportunity to inspect the work of the Station in all of its departments.

The Bulletins and reports of the Station, will be mailed regularly, free of charge to all residents of the State who request it.

ADDRESS:
AGRICULTURAL EXPERIMENT STATION,
College Park, Maryland.

THE MARYLAND
AGRICULTURAL EXPERIMENT STATION.

Bulletin No. 71. February, 1901.

NOTES ON SPRAYING PEACHES AND PLUMS IN 1900.

C. O. TOWNSEND AND H. P. GOULD.*

FRUIT ROT.

One of the most serious obstacles in the way of growing and marketing peaches, plums, and stone fruits generally, is the disease known as Fruit Rot. This disease was particularly destructive in this state in 1898, attacking both peaches and plums, and causing a loss of not less than one-fourth of the entire crop of these fruits. In 1899 the failure of practically the whole crop of peaches and plums from other causes precluded the possibility of carrying on experiments for the control of the Fruit Rot. The season of 1900 gave promise early in the year of a large crop of all kinds of fruits and the promise was entirely fulfilled so far as the quantity of fruit was concerned, although the quality was not the best in all cases. Fruit Rot, like most fungous diseases, depends largely upon weather conditions, and since it is impossible to forecast the conditions of the weather for the entire season, it is important to begin preventive measures early enough to keep the fungus from becoming established. In accordance with these observations we began our experiments early in the season before growth had started, with the object in view of finding the best means of controlling the Fruit Rot in this State, and incidentally of determining the general effect of fungicides upon the fruit and foliage of peaches and plums. The weather conditions were such that very little Fruit Rot developed during the past season, and in those orchards where our experiments were carried on there was so little rotting of the fruit that the primary object of our work was defeated. However the effect of the fungicide was so marked upon the foliage and was so beneficial upon the fruit that it has been considered advisable to present the results of our experiments to the growers at this time. In passing, a few facts in regard to Fruit Rot and the methods used in combating it may be of interest and value. While the Fruit Rot seems to depend upon weather conditions, the Rot is due primarily to the presence of a fungus (Monilia fructigena.) This fungus depends very largely for its development upon the state of the weather, and since the fungus itself is invisible without the aid of a microscope, we are liable to think of the weather as the real

*The observations made by Mr. Gould in this connection were purely from the horticultural standpoint.

cause of the Rot. If we compare the weather conditions during the summer months of 1898 with those of corresponding months for 1900, we shall see how the weather controls this disease and to what extent the fungus depends upon external conditions. The most important weather conditions are moisture and temperature, for upon these two the development of the fungus depends, providing the fungus spores are present and in contact with a substance from which the fungus is capable of drawing its food supply. The following table gives a comparison between the rain-fall and the temperature respectively for the corresponding summer months of 1898 and 1900. Table 1 showing the average monthly rainfall in inches and the average monthly temperature in degrees Fahrenheit, with departures from the normal during the summer months of 1898 and 1900 for the two principal peach growing sections of the State.

	RAIN-FALL				TEMPERATURE.			
	1898		1900		1898		1900	
	Normal	Departure from Normal	Normal	Departure from Normal	Normal	Departure from Normal	Normal	Departure from Normal
	WESTERN MARYLAND.							
May	4.64	+1.03	2.41	—1.18	62.2	—0.3	61.3	—0.8
June	1.96	—1.76	4.13	+0.68	69.8	+0.6	70.4	+0.6
July	3.48	—0.78	4.13	—0.67	75.8	+3.1	75.1	+1.7
Aug	6.69	+4.39	2.66	—0.63	72.5	+1.3	76.2	+4.9
Sept	1.34	+1.06	1.50	—1.38	66.9	+0.6	70.8	+4.9
Oct	6.00	+4.26	1.99	—1.36	54.3	+3.1	58.8	+7.2
	EASTERN MARYLAND.							
May	4.12	—0.14	2.53	—1.00	62.2	—1.5	64.2	—0.1
June	2.25	—0.44	4.06	+1.48	72.0	—0.3	72.1	+0.1
July	3.73	—1.24	3.03	—1.16	77.8	+1.4	78.8	+2.5
Aug.	6.05	+3.54	3.72	+0.21	76.8	+2.3	78.4	+3.0
Sept.	2.24	—0.34	5.86	+2.54	71.2	+1.4	72.5	+3.0
Oct.	4.19	+0.71	2.02	—1.09	59.3	+3.0	62.0	+4.7

*This table is compiled from the reports of the Weather Bureau for Maryland for the two years under consideration.

It must be remembered that these averages are made up by taking the daily rainfall and the daily temperature respectively, adding them together and dividing by the number of days in the month, hence it is possible for the figures to be somewhat misleading; e. g., if there was an excessive rainfall for several days in the early part of the month and little or no rainfall during latter part of the month, the average for the month might be very nearly normal. However an excessive average rainfall indicates that the atmosphere was extremely moist on one or more days during the month. It is not especially important in this connection to know whether

the rainy days followed each other closely or whether they were scattered throughout the month, although it is well known that several rainy days in succession are much more conducive to the development of Fruit Rot than the same number of rainy days scattered through the month. An important point brought out by this table is seen by comparing the rainfall in August 1898 with that of the same month for 1900. In 1898 the Fruit Rot was very bad in August and the rainfall was 6.69 inches or 4.39 inches above the normal; while in 1900 when there was no rot, the rainfall for August was only 2.66 inches, which was a little more than half an inch below the normal. It is also a note worthy fact that for the two months preceding August 1898 the rainfall was below the normal and very decidedly so during the month of June; whereas in 1900, August was not preceded by an excessively dry period. In this connection it will be remembered by those who have noticed the matter that an exceedingly moist period preceded by a very dry spell is usually accompanied by an outbreak of fungous diseases. In 1900 this condition does not obtain in any case. Hence, so far as the rainfall is concerned, we find just the conditions that favor the development of Fruit Rot, while in 1900 we do not find those conditions prevailing.

In regard to the temperature we do not find any excessive departure from the normal either in 1898 or in 1900. The greatest variation is to be found in 1900 when the temperature was nearly five degrees above the normal, a condition that is in itself favorable to the development of the Rot but which was fortunately accompanied by a rainfall that was below the normal. Had the rainfall for these two months been as great as in the corresponding months for 1898, undoubtedly the Fruit Rot would have been even more destructive than during that season. However the fact must not be lost sight of that if the fungus could be destroyed or prevented from coming into contact with the fruit, the Rot would not be produced regardless of weather conditions. Where no preventive measures are used the spores come into contact with the surface of the fruit, and under favorable conditions produce slender fungous threads that grow into the fruit and form the brown spots so characteristic of this disease. If the atmosphere is warm and an abundance of moisture is present, the fungus develops very rapidly so that from a set of spores new fungi may develop, complete their growth, and form a new set of spores within twenty-four hours. These spores are capable of germinating at once, and from the fungi thus produced a new set of spores may be formed within the next twenty-four hours. In this way the disease works rapidly, spreading from tree to tree as the spores are carried by the wind. It oftens happens that all the fruit on a tree or on a block of trees may be destroyed in a single day by a rapid spread and development of this fungus. When the fungus has nearly reached its growth it divides into several branches, each of which becomes pinched off at the ends, thus forming several chains of spores, and in this manner a large number of spores may be formed from a single spore in a few hours. If the conditions are not favorable for the germination of the spores, they may retain their vitality even for several years. When the fruit is allowed to remain on the tree after it has been attacked by the fungus, it becomes permeated by the fungous threads, and dries down forming what are known as "mummified

fruits." These mummies soon become covered with an ash grey powder composed of an infinite number of fungous spores. This fungus not only attacks the fruit but it may appear on the blossoms and extend down even into the twigs, as has been known for several years. Hence there is danger of an attack of this fungus from the time the blossoms are open until the fruit is marketed. However the most critical periods for the development of this disease are, 1st, when the blossoms are open, and 2d, when the fruit is ripe or nearly ripe. The Fruit Rot fungus in this state has been most destructive at the ripening season of the fruit. It is not uncommon for the fruit to be destroyed by an attack of this fungus even after it has been packed and is on its way to the market. This condition is brought about by the rapid development of the fungus from spores that had lodged on the fruit previous to the packing.

If this fungus grows downward into the twigs either from the diseased blossoms or from the decaying fruit, as it sometimes does, the twigs are killed for several inches from the tip, producing what was formerly known as the twig blight of the peach and plum. The effect thus produced on the trees is very similar in appearance to the pear blight or fire blight that has been so common and destructive on apple and pear trees for several years. It has been found, however, that while the twig blight of peaches, plums etc., is produced by the Fruit Rot fungus, the pear blight or fire blight of the apple, pear, and similar fruits is produced by bacteria.

Preventive Measures.—The first step toward the prevention of the Fruit Rot consists in gathering and burning all the mummified fruits in the fall or early spring. This should be followed by gathering from the trees and from the ground under the trees all fresh fruit that shows any signs of decay, and burning it.

In one of the few orchards in Maryland that produced a fairly good crop of peaches in 1899, the rot was held in check to a very satisfactory degree throughout the entire season by following this plan systematically. The second step in the control of Fruit Rot consists in using some fungicide that will prevent the spores from developing into fungi on the surface of the fruit. Probably the most satisfactory fungicide for this purpose is Bordeaux mixture, at least for the early spraying. Unfortunately this fungicide cannot be used for the late sprayings when the fruit is approaching the ripening period, as it is liable to stain the fruit and thus render it unfit for market. For the late sprayings, that is, after the fruit begins to color and ripen, it is better to use some colorless fungicide like ammoniacal carbonate of copper or acetate of copper. The latter is prepared by dissolving six ounces of copper acetate in fifty gallons of water and stirring until it is thoroughly mixed. In preparing the Bordeaux mixture for spraying peaches and plums it should be remembered that the foliage of these trees is comparatively tender *and would be injured by a mixture of the ordinary strength.* It is possible, however to get a mixture that will be effective, and that will not seriously injure the foliage by preparing Bordeaux mixture as follows: Dissolve three pounds of bluestone in water and dilute to twenty-five gallons, slake six pounds of good stone lime and dilute to twenty-five gallons; then pour the two

solutions together and stir vigorously. The number of sprayings will depend upon weather conditions, but as a rule there should be from three to five applications. The first application of Bordeaux mixture should be made before the blossoms open; this should be followed by another spraying soon after the fruit is set, and repeated at intervals of two or three weeks until near the ripening season. Hence the number of sprayings must depend not only upon the weather conditions but also upon the variety of fruit treated, and especially as to whether the fruit ripens early or late. Too much emphasis cannot be placed upon a proper preparation of the fungicide and upon a thorough, systematic application of the same. Even a smaller quantity of bluestone than three pounds to fifty gallons of water may be injurious to the foliage if a large excess of lime is not used, as is shown in Fig. 8, where only two pounds of bluestone with but a slight excess of lime were used in spraying plum foliage, and the same principle applies to peach foliage. In applying the fungicide care should be taken to cover the entire surface of the foliage and branches, and as soon as the fruit has set special pains should be taken to cover it with the fungicide at each spraying. In order to avoid staining the fruit with Bordeaux, Prof. Quaintance of Georgia recommends the use of Copper Acetate for the applications within three or four weeks of the time of the ripening of the fruit. It should also be noted that the application of fungicides aside from their influence in preventing rot and other fungous diseases has a very beneficial effect upon the fruit in giving to it a firmer texture, thus enabling it to go onto the market in a much better condition than it would otherwise do. This point will be more fully brought out in another connection.

CONCLUSIONS.

1. Fruit Rot may be controlled by spraying the trees with properly prepared fungicides. The number of applications required will depend upon the variety of fruit and upon the weather conditions.

2. As a precaution against the Fruit Rot all mummified fruits should be gathered and destroyed in the winter or early spring; and at picking season, no decayed fruit should be allowed to remain on the trees or on the ground in the orchard, but it should be gathered and burned as soon as noticed.

3. The best fungicide for early sprayings is Bordeaux mixture. This mixture must contain not more than three pounds of bluestone and at least six pounds of lime per barrel. The late spraying should be done with a colorless fungicide.

4. Aside from preventing the Fruit Rot, spraying has a beneficial influence upon the texture of the fruit, especially of peaches.

EXPERIENCE IN SPRAYING PEACHES.

The experiments outlined below were conducted in the orchard of Mr. Raleigh Sherman, who co-operated to the fullest extent possible in the work. As previously stated, the principal object in view in conducting these experiments was to control the Fruit Rot, but although this disease did not appear to any appreciable extent, another fungous disease known as Black Spot was abundant and therefore very destructive.

FIG. 8.—FOLIAGE INJURED BY BORDEAUX MIXTURE (4-4-50) PRODUCING WHAT IS COMMONLY KNOWN AS THE SHOT-HOLE FUNGUS EFFECT.

Black Spot is produced by a thread fungus somewhat similar in structure to the Monilia that produces the "Fruit Rot." The black spot fungus usually attacks one side of the peach only and prevents the diseased side from growing, thus producing a one-sided fruit. In addition to this, the diseased side assumes a black or brown color and eventually cracks, thus rendering the fruit practically worthless either for market or for home use. It is apparent that this fungus is not affected by the same weather conditions that prevent the development of Monilia, since the Fruit Rot failed to develop where the Black Spot flourished. The same treatment that will prevent the Fruit Rot from developing will also control the Black Spot. Furthermore the spraying that will prevent the Black Spot will exert a beneficicl influence upon the texture of the fruit, as will be seen in the following experiments:

The varieties of peaches which entered into the experiments were Chair's Choice, Salway, Smock and Heath Cling. The first spraying was done March 23rd. A portion of the trees were sprayed with normal Bordeaux; the remainder with Bordeaux containing three pounds of bluestone to a barrel of water. (The potassium ferro-cyanide test for the lime was used in each case, a large excess of lime being added). The second application was delayed until May 26th. The trees were, of course, in full foliage at this time and growing vigorously. A portion of the trees treated March 23rd were omitted at this time to study the effect of a single, early application; also another lot was given the first application on this date. All of the spraying at the second application was with the weaker Bordeaux (3 lbs bluestone) to avoid injury to the foliage. However, the leaves were somewhat damaged by this strength though not seriously. The third and last application was made June 29th. On account of the injury worked by the spray May 26th, a still weaker Bordeaux was made, using two pounds of bluestone to a barrel of water. But even this strength produced a slight shot-hole-fungus effect. One lot of trees received their first treatment on this date.

The following is a concise summary of the spraying: One lot sprayed very early, March 23rd; one lot sprayed March 23rd, May 26th and June 29th; one lot sprayed May 26th and June 29th.

Results: As previously stated, no comparisons could be made as to the effect of the treatment on the Fruit Rot, since practically none of it developed in the orchard. However, the effects of the spraying were very marked in the texture, firmness, and size of the fruit, and the absence of the Black Spot. In all the varieties, the trees sprayed only once, March 23rd, were no better than the unsprayed trees, but the fruit on the trees sprayed three times and those sprayed twice (May 26th and June 29th) was very decidedly better than on the untreated trees. There was no appreciable difference between these two lots—whether sprayed twice or three times. These results do not indicate any advantage in the early spraying before growth starts.

Fig. 9 compares the fruit taken from a sprayed and an unsprayed tree, the fruit on the left being from the former; that on the right from the latter. The fruit in the illustration was as nearly representative as it was possible to select. The sprayed lot was firm, solid, and almost entirely free from Black Spot; the unsprayed had a leathery texture, and much

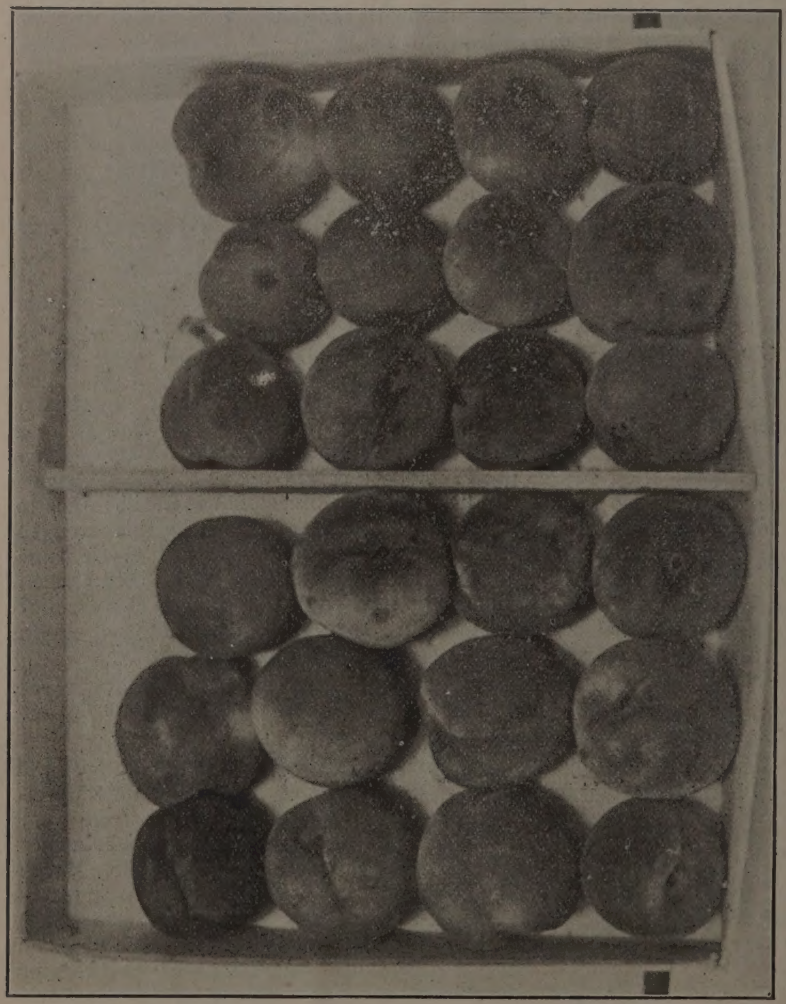

FIG 9.—REPRESENTATIVE FRUIT FROM A SPRAYED AND UNSPRAYED TREE. THE FORMER IS ON THE LEFT; THE LATTER ON THE RIGHT.

of the fruit was worthless on account of the Black Spot. The importance of continuing the spraying well up to the time of ripening is emphasized in the fact that the earliest variety in the test, Chair's Choice, showed the most decided improvement of any of the varieties. The longer time that elapsed between the last spraying and the maturity of the later varieties gave more opportunity for the development of fungous diseases. But as before stated, the difference in the later kinds was decidedly marked. The fruit in the illustration is one of the later varieties.

The following letter from Mr. Sherman who has observed the results very carefully, is significant:

CHAS. O. TOWNSEND, ESQ.. NOVEMBER 3, 1900.
State Pathologist,
College Park, Md.

MY DEAR SIR:—In reply to your letter of some days ago requesting my opinion in the matter of the experimental work in spraying fruit trees to prevent Black Spot and other fungous diseases in my orchard this season, I am pleased to inform you that the result was most apparent, gratifying and profitable. In the most positive way permit me to assure you of your success, and to express my belief in the practicable, beneficial and profitable results of spraying.

Crossing my orchard as you did from east to west and spraying Chair's Choice, Salway, Smock and Heath Cling, demonstrated the greatest value of your work alike on different varieties. The treatment produced perfect fruit; there was no black spot or other fungous growth, no mottled spots or withered sides; the texture was fine, and the fruit was plump, well developed, and highly colored, with a staying power on and off the tree that seemed remarkable. My sales and shipping book indicate that the sprayed trees ripened from ten days to two weeks later in the varieties indicated, and that the sales in every instance were at a higher rate, due, I believe, to the superior quality of the fruit, which was so apparent that it was the common talk of the pickers. One even ventured his weekly earnings that he could designate, blindfolded, the sprayed from the unsprayed fruit on the trees in the same varieties, and no one dared cover his offer.

I trust that it will be possible for you to continue your good work next season, and for the benefit of all fruit growers that you will give wide publication of your method.

At this early day it gives me pleasure to extend to you a most cordial invitation; and to assure you that you and all the state officials will always be very welcome in my orchards.

Sincerely yours,
(Signed) RALEIGH SHERMAN.

In addition to this letter, little need be said in regard to spraying peaches either from the standpoint of preventing disease or with a view of improving the texture of the fruit. It is important, however, to consider the cost of spraying in order to determine whether or not it will pay to spray. During the past season bluestone could be obtained at from five and one half to seven cents per pound, and using three pounds of bluestone to fifty gallons of water would make the bluestone cost, at the highest rate, twenty one cents per barrel. Stone lime may be obtained in Western Maryland at a price so low that the cost need not be considered,

and in sections where it is necessaay to purchase it in bulk it may be had for one-half cent per pound. Hence six pounds or enough for one barrel of Bordeaux mixture would cost three cents, thus placing the cost of material for one barrel of Bordeaux mixture at twenty-four cents, or a little less than a half cent a gallon. On an average one gallon will thoroughly spray one tree, hence the material for spraying one tree five times would cost less than three cents for the season. To this, of course, should be added the cost of labor. Three men can work to the best advantage; one to drive and do the pumping, and the other two to handle the nozzles using two lines of hose. The rapidity of the spraying will depend upon the individuals and upon the convenience of obtaining the water for the Bordeaux mixture, etc, but the expense for labor should not exceed three cents per tree for the five sprayings. Hence it is safe to say that an orchard may be sprayed thoroughly five times at an outlay of not more than six cents per tree.

CONCLUSIONS.

1. Bordeaux mixture containing 3 pounds of bluestone to a barrel of water applied the last of May is likely to injure peach foliage somewhat, but in our experience the injury is not enough to do any serious harm. The same is also true of Bordeaux containing two pounds of bluestone, applied the last of June.

2. Black Spot was almost entirely prevented and the texture and size of the fruit decidedly improved by two and three applications.

3. As the results from the trees sprayed May 26th and June 28 were as marked as from the trees receiving an application March 23rd in addition to the two later sprayings, it follows that the earliest application is without material advantage under the conditions existing at this time.

4. The spraying should be continued well up to the time of ripening of the fruit.

EXPERIENCE IN SPRAYING PLUMS.

Our work on plums was carried on for the most part in the orchard of Mrs. S. J. Cady, Keep Tryst, Washington County, Md Several parallel experiments were carried on in the orchard of Dr. S. S. Buckley, at College Park, Md. Mrs. Cady's orchard is eight or nine years old, in fairly good condition, and is composed of a large number of Japan and domestica varieties—in all, several hundred trees. Previous to this year the orchard had borne only one full crop of fruit. Many of the trees bore each year a small quantity of fruit, but this was nearly always destroyed by the rot.

The question of the unproductiveness of this orchard was presented to us and after an examination of the conditions, the most probable cause seemed to be the working of the Fruit Rot fungus early in the season, perhaps even during the blossoming period, as the trees bloomed full every year but the fruit failed to set. Accordingly our experiments were planned to determine, if possible, if this conjecture was correct. However, a full crop of fruit set on nearly the whole orchard, thereby defeating the particular object of the experiment. Yet the effort was not entirely barren of results, though so far as the controlling of the disease is

concerned, but little was accomplished. The fact that there was practically no rot in or near this orchard during the past season would tend to bear out, negatively at least, our conjecture in regard to the cause of the failure of the fruit to set in previous years. The following is an outline of the experiments, with the lessons which they teach:

On April 18th before growth had commenced, the first spraying was done. At this time three rows—A, B & C, were sprayed with Bordeaux mixture containing six pounds of bluestone to a barrel of water and more than enough lime to neutralize the bluestone. Light showers occurred frequently while the spraying was being done but examinations of the trees later made it evident that the material had not been seriously washed off. The second application was made May 11th. On this date the foliage was well out, and to avoid danger of injury to the leaves, the strength of the Bordeaux was reduced to four pounds of bluestone to a barrel of water. How much this caution availed will be explained later. At the second application four rows were sprayed, but this time B, C, D, and E; that is, one row, A, sprayed April 18th, was omitted and row E received its first treatment; rows B, C and D received their second application. The object of this was to throw whatever light was possible on the effect of spraying at different times. June 22nd was the date of making the third application. Rows A and B were not sprayed at this time; rows C and D were given a third spraying, E a second and F received its first treatment.

It had been our plan to use Bordeaux on these trees throughout the season but injury to the foliage of the Japan plums caused by the weak Bordeaux (4 lbs., Bluestone to a barrel of water) applied May 11th was so great that this plan was dropped and ammoniacal solution of copper carbonate used in its stead. However, one row (G) was sprayed with a very weak Bordeaux mixture containing two pounds of bluestone to a barrel of water. This completed the spraying for the season, making one row that received a single early treatment, one row that received the first two applications each being Bordeaux mixture; two rows that received three applications, the last being ammoniacal solution of copper carbonate; one row had the two later applications, and two rows had only the last spraying, one being sprayed with ammoniacal solution of copper carbonate, the other with very weak Bordeaux.

The orchard was visited frequently and a summary of the notes that were taken from time to time is given below.

EFFECT ON DOMESTICA VARIETIES.

The domestica varieties seemed to be entirely uninfluenced by any of the applications so far as the Fruit Rot was concerned, there being as much rot on the sprayed trees as on the unsprayed. The Japan kinds appeared to be rather more amenable to the treatment, though the results were not so satisfactory as it was hoped that they would be. Row A, which received only the early application and rows F and G which were given only the latest spraying showed no influence of the fungicides. The three other rows showed some improvement in the condition of the fruit though it was not very marked.

EFFECT ON FOLIAGE.

The effect on the foliage was much more emphatic than upon the fruit, though this effect was anything but pleasing. The domestica varieties were in no wise injured but the extreme tenderness of the Japan sorts was very emphatically demonstrated. As above stated, the Bordeaux containing four pounds bluestone to a barrel of water applied May 11th, was so severe that its use at this strength was precluded. Many of the leaves dropped within a few weeks after the spraying and nearly all that remained on the trees were full of small holes where the tissues had been injured. These subsequently died and broke away from the healthy tissue. (Fig. 8.) A good many of these leaves fell prematurely, but the trees put out many new leaves so that on examination Sept. 19th the loss of foliage was not conspicuous, though the "shot-hole-fungus effect" was still apparent on the older foliage.

July 14th it was noted that there was no apparent injury from the Bordeaux containing two pounds of bluestone to a barrel of water, but on Sept. 19th practically all the leaves had fallen while the unsprayed trees were in full leaf. It may be well to state that the "potassium-ferrocyanide test" was used for the lime, in the Bordeaux, a large excess of lime being added. The ammoniacal solution applied June 22d produced considerable "shot-hole-fungus effect," but not enough to cause any serious dropping of the leaves. This injury was apparent on July 14th but on this date it manifested itself merely in the spotting of the leaves, while later this injured tissue dropped out of the leaves, leaving the holes referred to.

A summary of the condition of the foliage Sept. 19th may be briefly stated as follows :

From the ammoniacal solution the effects were slight as to the dropping of the foliage but there were many holes in the leaves; from the Bordeaux with four pounds of blue stone, many leaves showed the holes or "shot-hole-fungus effect"; a considerable portion dropped after the application but it was made early enough so that many new leaves put forth making the lack of foliage unnoticeable at this date. From the Bordeaux with two pounds bluestone, the trees were nearly defoliated. Perhaps it should be stated that,without doubt, the foliage in mid-season is more susceptible to injury from sprays than it is early in the spring.

The plum trees owned by Dr. Buckley are young and in a healthy condition. The few crops that the trees have borne in previous years rotted for the most part before they ripened and it was fair to suppose that under the same conditions the rotting would be repeated. As already stated it was impossible to foretell what the conditions would be, hence we began spraying soon after the leaves had developed. The first application was made on May 8th and this was followed by a second spraying on May 23rd. The varieties sprayed were Abundance and Ogon. Several trees of each variety were sprayed and a number of each were left with no treatment. Two strengths of Bordeaux mixture were used, viz: Four pounds of bluestone and four pounds of lime to fifty gallons of water and two pounds of bluestone and two pounds of lime to fifty gallons of water. Both these strengths of Bordeaux mixture were very injurious to the foliage, a large part of which dropped off, the remainder

being badly injured by the fungicide. The Bordeaux made up on the 2-2-50 formula produced just as much injury as did the stronger mixture. In all probability a large excess of lime would have prevented the injury with the plums as it will in the case of peaches. The sprayed trees soon put out new foliage but it did not reach the same size and it remained somewhat paler in color than the original foliage.

The effect of the injury to the foliage was as marked in the development of the fruit as it was in the development of the new foliage. Nearly all the blossoms on both the sprayed and the unsprayed trees set fruit so that all the trees were loaded, but on the sprayed trees where the foliage was severely injured the fruit was very much smaller than on the unsprayed trees. It was also noticeable that the fruit on the trees with the injured foliage was much inferior in quality to the fruit on the unsprayed trees. This serves to show how the size and quality of the fruit depend upon a normal development of the foliage. If the foliage is injured in any way whatever, whether it be by artificial means as in the case just described or by some natural cause, as in the case of a fungous disease, the result will be the same so far as the size and quality of the fruit is concerned. No fungous disease of any importance appeared either on the fruit or on the foliage of any of the trees whether sprayed or unsprayed. It is true that a few cases of Fruit Rot appeared late in the season, but they were very few in number and just as many appeared on the sprayed as on the unsprayed trees; hence no conclusions could be drawn in regard to the effect of the spray upon either the Fruit Rot or other fungous diseases.

CONCLUSIONS.

From the season's experience,

1. Bordeaux mixture seems to be more effective in preventing Fruit Rot of Japan plums than of the domestica varieties.

2. To be effective in preventing this disease, the spraying should be begun early in the season, but the value of an application before the foliage puts forth was not demonstrated in the fore-going experiments. The application should be continued near to the period of ripening.

3. Bordeaux mixture containing four pounds of bluestone to a barrel of water applied in May will seriously injure the foliage of Japan plums.

4. Bordeaux mixture containing two pounds of bluestone to a barrel of water applied as above, the last of June will seriously injure the foliage. This strength, however, might be safe earlier in the season.

PUBLICATIONS

OF THE

MARYLAND AGRICULTURAL EXPERIMENT STATION.

These bulletins are sent free of charge to any address upon application to the Director of Experiment Station, College Park, Maryland.

Only the bulletins named below are available for distribution.

Bulletin No. 6, Sept., 1889, Commercial Fertilizers.
" " 8, March, 1890, Feeding Old Milch Cows for Beef.
" " 12, March, 1891, Pig Feeding.
" " 26, June, 1894, Tobacco.
" " 29, Dec., 1894, Further Investigation on the Soils of Maryland
" " 31, March, 1895, Potato Experiments.
" " 32, April, 1895, The San Jose Scale.
" " 33, April, 1895, Horticultural and Agricultural Departments; Small Fruits, Vegetables and Field Corn.
" " 34, July, 1895, Composition of Commercial Fertilizers sold in this State.
" " 35, Sept., 1895, Wheat, Barley, Oats and Hay Experiments.
" " 37, Feb., 1896, Composition of Commercial Fertilizers sold in this State.
" " 38, March, 1896, Potato Experiments.
" " 39, April, 1896, Spray Calendar.
" " 40, Aug., 1896, Composition of Commercial Fertilizers sold in this State.
" " 41, Sept., 1896, Test of Methods of Preparing and Feeding Corn Fodder
" " 42, Oct., 1896, The Maryland Trees and Nursery Stock Law and Other Information of Special interest to Nurserymen and Fruit growers.
" " 43, Dec., 1896, Report upon the Value of a New Corn Product.
" " 47, June, 1897, Dairy Farming.
" " 48, June, 1897, Some Common Injurious Plant Lice with Suggestions for their Destruction.
" " 49, Aug., 1897, Composition of Commercial Fertilizers sold in this State.
" " 50, Sept., 1897, Rust and Leopard Spot, Two Dangerous Diseases of Asparagus.
" " 51, Dec., 1897, Horse-Feeding; Tests of the Digestibility of Oats, Corn, Hay and the New Corn Product.
" " 52, Feb., 1898, Composition of Commercial Fertilizers sold in this State.
" " 53, March, 1898, Special Investigation of the So-called "New" Horse Disease in Maryland.
" " 54, March, 1898, Tomatoes.
" " 56, June, 1898, Wheat, Winter Oats, Barley and Lime Experiments.
" " 58, Aug., 1898, The Hessian Fly and Wheat Diseases.
" " 59, Jan., 1899, Sweet potato Insects.
" " 60, March, 1899, Some Diseases of Sweet potato.
" " 61, June, 1899, The Sugar Beet in Maryland.
" " 62, June, 1899, Experiments with Wheat, Corn and potatoes.
" " 63, Dec, 1899, Experiments with Feeding Pigs.
" " 64 Jan. 1900, A Study of the Cause of Mottled Butter.
" " 65, March 1900, Insecticides, Fungicides and Spraying Apparatus.
" " 66, May 1900, Lime—Sources and Relation to Agriculture.
" " 67, June 1900, The Culture and Handling of Tobacco.
" " 68, Sept. 1900, Fertilizer Experiments with Phosphoric Acid.
" " 69, Oct., 1900, Influence of Feed on the Individuality of Cows.
" " 70, Jan. 1901, The Chemical Composition of Maryland Soils.

CONTENTS.

NOTES ON SPRAYING PEACHES AND PLUMS IN 1900.

Page.

Fruit Rot 115

Rainfall and Temperature 1898 and 1900 116

Means for preventing Fruit Rot 118

Strength of Solution used in Spraying 118

Method of Making Bordeaux for Spring for Fruit Rot 118

Conclusions drawn from Experiments conducted on Fruit Rot 119

Effects of Spraying on Black Spot in Peaches 119

Experience in Spraying Plums 124